

REMARKS

Status of Claims

Claims 43, 45 and 47 are canceled, claims 44, 46, and 48 are each rewritten in independent form, and new claims 119-123 are presented. As a result, claims 38-40, 44, 46 and 48-123 are pending.

New claim 119 is a re-presentation of former claim 34 (in independent form) as it had been pending in the amendment filed December 14, 2004.

New claims 120 and 122 are re-presentations (in independent form) of former claims 7 and 23, respectively, as they were pending in the amendment filed December 14, 2004. New claims 121 and 123 find support in former claims 7 and 23 as they had been pending in the amendment filed December 14, 2004.

No new matter is entered by this Amendment.

For purposes of the prosecution of this patent application only, Applicant states that some or all of the claims that will be pending in this application upon the entry of this Amendment were previously presented in this Application, and were pending herein prior to July 6, 2005, and may be considered to interfere with some or all of the claims of U.S. Patent 6,759,984 to Wielsma upon the said pending claims herein being found otherwise allowable.

Allowable Subject Matter

Applicant thanks the Examiner for the indication that claims 38-40 and 49-98 recite allowable subject matter. Claims 43-48 were indicated as both allowed and rejected in the previous Action; the Examiner explained during the interview that those claims were accidentally listed as allowed and were in fact rejected.

Interview Summary

Applicant thanks the Examiner for the courtesies extended during an interview at the Office on May 30, 2007 with the undersigned attorneys. During the interview, the Examiner and representatives of the Applicant discussed the issues presented in the Examiner's interview summary of May 30, 2007.

Claim Rejections: 35 U.S.C. § 103

Claims 43-48 and 99-118 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,384,785 to Kamogawa et al. ("Kamogawa") in view of U.S. Patent 5,530,919 to Tsuru et al. ("Tsuru"). The Examiner cited Tsuru as showing an antenna in a mobile phone, and cited Kamogawa for the remainder of the claim limitations.

In response, Applicant has cancelled claims 43, 45 and 47, and rewritten claims 44, 46, and 48 in independent form.

Applicant asks the Examiner to reconsider and withdraw the rejection as to claims 44, 46, 48 and 99-118 for the following reasons.

Claims 44 and 46

Claims 44 and 46 each include the limitation that "the PCB is apertured adjacent to the element."

The Examiner cited Kamogawa, and in particular Figure 6 thereof, in rejecting these claims. However, nothing in Kamogawa Figure 6 discloses apertures in a printed circuit board (PCB) adjacent to an antenna element. In Kamogawa Figure 6, the antenna elements 12, 12a are located on dielectric layers 2 which contain no apertures. Even if slot 16 could be considered to be an aperture in the PCB (which construction Applicant does not agree with), it would be an aperture in the ground plane 11, 11a, which is a metallic conductor, not an aperture *in the PCB*. Metallic conductors formed *on* PCB layers do not themselves form part of the PCB.

This distinction is clear from the present application's specification, which clearly and consistently distinguishes the disclosed and claimed antenna element and ground plane from the PCB. For example, in describing or referring to the antenna elements, the specification repeatedly and consistently refers to them as being "on" the layers of the PCB, rather than as being "in" the layers, or being part of the layers:

"conductor patterns *on* a plurality of layers of a multilayer PCB"
(paragraph 0004, emphasis added)

"F-shaped conductor pattern *on* a first layer of the PCB and an I-, L- or F-shaped conductor pattern *on* the or each other layer" (paragraph 0007, emphasis added)

"FIG. 2 illustrates the arrangement of an antenna according to the present invention *on* the main PCB of the mobile phone of FIG. 1"
(paragraph 0013, emphasis added)

"an F-shaped region 42 of conductor is left on the first layer 40a"
(paragraph 0025, emphasis added)

"a plurality of antennas be formed on the same PCB or in the same way on different PCBs" (paragraph 0031, emphasis added)

So Kamogawa's Figure 6 does not disclose a PCB that is apertured adjacent to the element. Similarly, Tsuru does not disclose any apertures in printed circuit board 2 or 32. Accordingly, these claims should be allowed.

In this connection, it should be recognized that in Applicant's device the aperture in the dielectric adjacent to the antenna element "reduces the amount of lossy PCB material in the vicinity of the antenna." Substitute Specification, paragraph [0006]. (See also paragraph [0029].) No such purpose would be served by an aperture in a metallic ground plane.

Claim 48

Claim 48 requires that the "the interconnection is by *vias* extending through the at least one buried layer of the PCB." (emphasis added). That is, this limitation requires

that conductor patterns comprising the antenna element be interconnected *by more than one via* extending through at least one buried layer of the PCB.

However, Figure 6 of Kamogawa does not contain more than one via *connecting conductor patterns that comprise an antenna element*. In Kamogawa Figure 6, the multiple vias 19 couple ground planes, not antenna elements. (In Kamogawa Figure 5, there is only a single via 19 between the antenna trace 12 and the strip conductor 13.) Accordingly, Kamogawa Figure 6 does not disclose interconnection of the antenna element conductor patterns by more than one via through the at least one buried layer.

Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

Claims 99-119

There are five independent claims among these 21 claims: 99, 104, 109, 112 and 116. We discuss them in order.

Independent claim 99:

As discussed above, the Examiner cited Kamogawa, and in particular Figure 6 thereof, in rejecting these claims. But Kamogawa Figure 6 lacks at least three limitations recited in this claim:

1. “antenna traces located on opposing surfaces of said substrate interconnected by vias extending through said substrate”

This limitation requires that two or more antenna traces, located on opposing surfaces of a substrate, be interconnected *by more than one via* extending through the substrate. However, Figure 6 of Kamogawa does not contain more than one via *connecting antenna traces*. In Kamogawa Figure 6, the vias 19 couple ground planes, not antenna traces. (In Kamogawa Figure 5, there is only a single via 19 between the antenna trace 12 and the strip conductor 13.) Accordingly, Kamogawa Figure 6 does not disclose

more than one electrically conductive via extending through said substrate, coupling an antenna trace to another antenna trace.

Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

2. “an insulation region extending through said substrate and located between said antenna trace and said ground plane”

This limitation requires *an insulation region* extending through a substrate and located *between an antenna trace and a ground plane*. However, nothing in Kamogawa Figure 6 discloses “an insulation region extending through said substrate” and located between an antenna trace and ground plane.

In Applicant’s device, an “insulation region” is not the dielectric layer. Rather, it is an aperture or other opening in the dielectric layer, which can serve the purpose of “reduc[ing] the amount of lossy PCB material in the vicinity of the antenna.” Substitute Specification, paragraph [0006]. (See also paragraph [0029].) Kamogawa Figure 6 discloses no such “insulation region” extending through a substrate and located between an antenna trace and a ground plane. In Kamogawa Figure 6, the antenna elements 12, 12a are located on dielectric layers 2 which have no insulation regions extending through them. Even if slot 16 could be considered to extend through a substrate, it is not an insulation region located between an antenna trace and a ground plane, in that it is cut in the ground plane 11, 11a, and couples the antenna element 12, 12a above to the strip conductor 13 below; it could be considered to be located between the antenna element 12, 12a and the strip conductor 13, or between the ground planes 11, 11a, but it is not located between the antenna element 12, 12a and the ground planes 11, 11a.

Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

3. “an antenna trace formed on a substrate ..., said antenna trace proximate a ground plane of said substrate”

This limitation requires that a substrate contain an antenna trace, and that *the same substrate also contain a ground plane*. Figure 6 of Kamogawa does not contain one or more antenna traces *on the same substrate* as one or more ground plane elements. The Kamogawa designs include ground planes and antenna elements always disposed on *different substrates* within the overall structure.

Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

Independent claim 104:

This independent claim contains the substance of the same three limitations, discussed above, which Kamogawa Figure 6 lacks:

1. “antenna traces located on opposing surfaces of said substrate interconnected by vias extending through said substrate”

Claim 104 contains this limitation in the same words as claim 99. Kamogawa Figure 6 does not disclose this limitation for the reasons set forth above with respect to this limitation in claim 99. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

2. “an insulation region extending through said substrate and located between said antenna trace and said ground plane”

Claim 104 contains this limitation in the same words as claim 99. Kamogawa Figure 6 does not disclose this limitation for the reasons set forth above with respect to this limitation in claim 99. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

3. “an antenna trace formed on a substrate ..., said antenna trace proximate a ground plane of said substrate”

Claim 104 contains the substance of this limitation, in the following words: “forming an antenna trace on a substrate proximate a ground plane of said substrate.” Kamogawa Figure 6 does not disclose this limitation for the reasons set forth above with respect to this limitation in claim 99. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

Independent claim 109:

This independent claim contains the substance of the same three limitations, discussed above, which Kamogawa lacks:

1. “antenna traces located on opposing surfaces of said substrate interconnected by vias extending through said substrate”

Claim 109 contains this limitation in the same words as claim 99. Kamogawa Figure 6 does not disclose this limitation for the reasons set forth above with respect to this limitation in claim 99. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

2. “an insulation region extending through said substrate and located between said antenna trace and said ground plane”

Claim 109 contains this limitation in the same words as claim 99. Kamogawa Figure 6 does not disclose this limitation for the reasons set forth above with respect to this limitation in claim 99. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

3. “an antenna trace formed on a substrate ..., said antenna trace proximate a ground plane of said substrate”

Claim 109 contains the substance of this limitation, in the following words: “a substrate ... having a ground plane ...formed thereon; and an antenna structure, including: an antenna trace formed on said substrate proximate said ground plane.” Kamogawa Figure 6 does not disclose this limitation for the reasons set forth above with respect to this limitation in claim 99. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

Independent claim 112:

Independent claim 112 contains the limitation:

“said antenna trace includes antenna traces located on opposing surfaces of said substrate interconnected by vias extending through said substrate”

This limitation requires that two or more antenna traces, located on opposing surfaces of a substrate, be interconnected by *more than one via* extending through the substrate. As has been discussed above, however, Figure 6 of Kamogawa does not contain more than one via *connecting antenna traces*. In Kamogawa Figure 6, the vias 19 couple ground planes, not antenna traces. (In Kamogawa Figure 5, there is only a single via 19 between the antenna trace 12 and the strip conductor 13.) Accordingly, Kamogawa Figure 6 does not disclose *more than one* electrically conductive via extending through said substrate, coupling an antenna trace to another antenna trace. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

Independent claim 116

Independent claim 116 contains the limitation

“a plurality of electrically conductive vias through said substrate, said plurality of vias coupling said first antenna trace to said second antenna trace.”

This limitation requires that two antenna traces be interconnected by *more than one via* extending through the substrate. As has been discussed above, however, Figure 6 of Kamogawa does not contain more than one via *connecting antenna traces*. In Kamogawa Figure 6, the vias 19 couple ground planes, not antenna traces. (In Kamogawa Figure 5, there is only a single via 19 between the antenna trace 12 and the strip conductor 13.) Accordingly, Kamogawa Figure 6 does not disclose *more than one* electrically conductive via extending through said substrate, coupling an antenna trace to another antenna trace. Tsuru similarly does not teach this limitation, so Kamogawa and Tsuru, even if combined, still fail to teach this limitation, and this claim is allowable over the art of record for this reason alone.

Dependent claims 100-103 depend from claim 99; dependent claims 105-108 depend from claim 104; dependent claims 110-111 depend from claim 109; dependent claims 113-115 depend from claim 112, and dependent claims 117-118 depend from claim 116. Insofar as claims 99, 104, 109, 112 and 116 are allowable, it follows that these dependent claims also are allowable.

New claim 119

Claim 119 was previously pending as claim 34, and was canceled. The Examiner rejected this claim in the Office Action of July 19, 2006 as unpatentable over Kane (U.S. Patent 6,057,803) in view of Alford (U.S. Patent 2,510,430).

However, claim 119 contains the limitation “the interconnection [of the conductor patterns of an antenna element] is by vias extending through the at least one buried layer of the PCB.” As discussed above in connection with claim 48, this limitation requires that conductor patterns comprising the antenna element be interconnected by *more than one via* extending through at least one buried layer of the PCB. Kane does not disclose such a feature. In particular, at column 11, line 60 to column 12, line 44 Kane discusses a “seventeenth embodiment” which is illustrated in Figures 28 and 29. Figure 29 is a view of a specific design of that embodiment, and discloses two antenna elements, on different

layers of a multilayer PCB, *connected by means of a single via, not multiple vias*. As Kane explicitly states, “[t]he connection between the antenna devices 292 and 293 . . . is enabled by passing a conductive material *through a through hole 294*.” Column 12, lines 32-35 (emphasis added) Figure 28(a), which is a schematic diagram of the antenna embodiment, is consistent, in that it discloses one connection between ground sides and one connection of the antenna elements to a common feeding point. (column 11, line 65 to column 12, line 3.) Thus, Kane teaches connecting antenna conductor patterns by a single via, not by multiple vias as claim 119 requires.

New claims 120-123

Claims 120-123 each require that “PCB is apertured between an upright of an F-shaped conductor pattern and a ground plane area.”

Kamogawa does not disclose this limitation. Kamogawa discloses strip conductors, such as conductor 13, not F-shaped conductor patterns. Moreover, Kamogawa’s apertures, as discussed above, are in ground plane 11, 11a, not *between* a conductor pattern and a ground plane area.

Claims 120-123 are also allowable over U.S. Pat. No. 6,057,803 to Kane et al. Kane, like Kamogawa, does not disclose creating an aperture in the PCB *between* a conductor pattern and a ground plane area. Rather, the aperture in Kane’s Fig. 29 through which via 294 runs is between conductor patterns, not between a conductor pattern and a ground plane area.

CONCLUSION

In view of the above remarks, Applicant believes pending Claims 44, 46-48 and 99-123 are in condition for allowance. (The Examiner allowed claims 38-40 and 49-98 in the previous Action.)

Applicant invites the Examiner to contact the Applicant's Attorneys if questions arise regarding this Response or if issues remain prior to allowance.

Respectfully submitted,

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